STARK STATE COLLEGE

GENERAL SYLLABUS

Course Information

Course Name: Compressor ION Nitriding
Course Number: ARL145

Required Materials

Textbook(s): Compressor ION Nitriding Handbook Ariel Corp.
Required Readings: None
Additional Materials: Scientific Calculator, Laptops, Note Pads, Writing Utensils, Web Links, Handouts and related items as provided in class.

Course Outline/Calendar

The date of coverage and order of coverage may be modified based on the faculty member and events beyond the control of faculty members that interfere with class times and teaching.

Week	Chapter/Topic/Lab
1 – Fundamentals of Surface Hardening	○ Introduction to heat treating and surface modification. ○ Comparison of various surface hardening methods (e.g., carburizing, nitriding, induction hardening). ○ History and development of nitriding.
2 – Basic Nitriding Principles	○ The metallurgy of nitriding: nitrogen diffusion, compound layer, and diffusion zone. ○ Types of nitriding processes: gas nitriding, salt bath nitriding, and ion (plasma) nitriding. ○ Advantages and disadvantages of each method.
3 – Introduction to Compressors	○ Basic principles of compressor operation and types (reciprocating, centrifugal, screw). ○ Common compressor components that benefit from nitriding (e.g., crankshafts, cylinders, gears). ○ Typical materials used in compressor manufacturing.
4 – The Ion Nitriding Process	○ In-depth look at the ion nitriding process: plasma formation, process atmosphere, and the role of nitrogen ions. ○ How ion bombardment and plasma discharge facilitate nitriding. ○ Key process variables: temperature, pressure, gas mixture, and treatment time.
5 – Ion Nitriding Equipment	○ Components of a typical ion nitriding furnace: vacuum chamber, power supply, gas supply system, and control systems. ○ Safe operation and maintenance procedures for ion nitriding equipment.

Week	Chapter/Topic/Lab
6 – Material Selection for ION Nitriding	○ Optimizing material properties for ion nitriding, including alloy steel selection. ○ The effect of different alloying elements (e.g., Cr, Mo, Al) on the nitriding process and final properties. ○ Pre-treatment considerations: heat treatment and surface finish.
7 – Process Optimization	○ The relationship between process parameters and metallurgical results (case depth, hardness, white layer thickness). ○ Iterative design and process optimization for specific applications.
8 – Component Preparation	○ Pre-cleaning requirements to remove oils, grease, and oxides. ○ Masking techniques to prevent nitriding on specific areas. ○ Proper loading of components into the furnace.
9 – Dimensional Control and Fixturing	○ Understanding and mitigating dimensional changes caused by ion nitriding. ○ Design and use of effective fixturing to ensure consistent results and prevent distortion.
10 – Post-Nitriding Procedures	○ Quenching and cooling procedures. ○ Optional post-treatment processes (e.g., polishing, finishing).
11 – Quality Control (Part 1)	○ Metallographic inspection: cross-sectioning and microscopy to evaluate case depth and white layer. ○ Microhardness testing (e.g., Vickers) to measure hardness profiles.
12 – Quality Control (Part 2)	○ Coupon testing: using sample coupons representative of the parts being nitrided. ○ Non-destructive testing (NDT) methods, including eddy current testing for case depth verification.
13 – Failure Analysis and Troubleshooting	○ Common defects in ion nitriding: excessive white layer, insufficient case depth, and adhesion issues. ○ Problem-solving techniques for process deviations.
14 – Practical Applications and Case Studies	○ Review of real-world applications of ion nitriding for reciprocating and centrifugal compressor components. ○ Discussion of specific industry standards and best practices.
15 – Practical Project	○ Students perform a complete ion nitriding process on a sample compressor component. ○ They will be responsible for component preparation, equipment setup, process execution, and post-processing evaluation.
16 – Final Review and Assessment	○ Presentation of project results. ○ Final written and/or practical exam covering all course material.